North Inlet – Winyah Bay (NIW) NERR Meteorological Station Metadata
January – December 2004
Latest Update: March 30, 2005

I. Data Set & Research Descriptors

1. Principal investigator(s) & contact persons

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2. Entry verification

A. Data Input Procedures:

Data are uploaded from the CR10X data logger or storage module to a Personal Computer (IBM compatible). Files are exported from PC208W or LoggerNet in a comma-delimited format (.DAT) and opened in Microsoft Excel for pre-processing with the EQWin format macro that was developed by the CDMO to reformat the header columns, insert station codes, insert a date column (mm/dd/yyyy), correct the time column format and reformat the data to the appropriate number of decimal places. The pre-processed file is then ready to be copied into the EQWin weather.eqi file where the data are QA/QC checked and archived in a database. EQWin queries, reports and graphs are used to discover data set outliers (values which fall outside the range that the instrument is designed to measure) and large changes in the data. EQWin is also used to generate statistics, view graphs, create customized queries and reports of the data, cross query the water, weather and nutrient data and finally export the data to the CDMO.

The 15-minute average data, 1-hour average data, and 24-hour average data were downloaded from each instrument on the weather station to a Campbell Scientific CR10X datalogger. The CDMO Data Logger Program (NERR_4B.csi) was loaded into the CR10X and controls the sensors and data collection schedule (see Part B of the Entry Verification section for the Data Collection Schedule). The CR10X then interfaced with the PC208W software supplied by Campbell Scientific via a short haul modem at Baruch Marine Field Lab (BMFL). The software is located on a computer in the System Wide Monitoring Lab at BMFL and the data are uploaded (every 5 minutes) via the short haul modem. The data were saved as a monthly raw data file (raw0104.dat) onto a separate hard drive and than backed up onto the BMFL server.

Once an entire month of data was available, the data were QA/QC'ed using Gemtek's EQWin program. The program produces averages, maximums and minimums every fifteen minutes (array 15), every hour (array 60), and every day (array 144) for all sensors hooked up to the CR10X. Any anomalous data were investigated and are noted below in Anomalous Data section. Any data corrections that were performed are noted in the Data Correction section below. Amy Cook is responsible for all data management of the Meteorological Data sets.

The most common reported errors / anomalies in the 2004 weather data were: Common errors noted in the monthly error reports were LiCor data less than 0 mmol/m^2, relative humidity greater that 100% and precipitation difference of greater than 5mm in 15 minutes. All errors of these types were double checked with other data that could support such "anomalous" weather changes and noted in the sections that follow.

The raw data files and the Gemtek EQWin's database were saved to Compact Disc for archival and backed-up on the server.

As of October 21, 2003, **Version 4.0** of the CR10X program, which was developed, by Bob Scarborough, is being used to control the sensors and data collection schedule. All data error checked, corrected, and archived will be imported into the EQWin database in the following manner:

B. Data Collection Schedule

1. Data is collected in the following formats.
   a. Sample data points are collected every 15 minutes.
      - Averages, minimums, maximums and their times
   b. Hourly averages are collected every 60 minutes.
      - Averages, minimums, maximums and their times
   c. Daily averages of hourly averages are estimated.
      - Averages, minimums, maximums and their times

      - The following parameters were collected:

Year, Julian Date, Time, Average Temperature (c), Maximum Temperature (c), Maximum Temperature Time, Minimum Temperature (c), Minimum Temperature Time, Relative Humidity Average (%), Relative Humidity Max (%), Relative Humidity Max Time, Relative Humidity Min (%), Relative Humidity Min Time, Barometric Pressure Average (mb), Barometric Pressure

Max (mb), Barometric Pressure Max Time, Barometric Pressure Min (mb), Barometric Pressure Min Time, Wind Speed Average (m/s), Wind Direction Average (degrees), Wind Speed Std Dev (m/s), Wind Speed Maximum (m/s), Wind Speed Maximum Time, Wind Speed Minimum (m/s), Wind Speed Minimum Time, Precipitation Total (mm), PAR Total (millimoles/M^2), Voltage Average (volts), Total Radiation (Langleys/Minute), Cumulative Rainfall (mm)

C. Error/Anomalous Data Criteria

Air Temp:
- 15 min sample not greater than *max* for the day
- 15 min sample not less than the *min* for the day
- 15 min sample not greater than 3.0 (^oC) from the previous 15 minutes
- max and min temp recorded for the day
- 1 hour average not greater than 10% above the greatest 15 min sample recorded in the hour

Relative Humidity:
- Not changed by more than 25% from the previous 15 minutes
- Max and min humidity recorded for the day
- 1-hour average not greater than 10% above the greatest 15 min sample recorded in the hour

Rainfall:
- Precipitation not greater than 5 mm in 15 min
- No precipitation for the month

Wind Speed:
- Wind speed greater than 65 m/s
- Wind speed less than .5 m/s

Wind Direction:
- Wind direction not greater than 360^0
- Wind direction not less than 0^0

Pressure:
- Pressure greater than 1040 mb or less than 980 mb
- Pressure changes greater than 5 mb per hour
- Maximum and minimum values recorded for the day
- 1-hour average not greater than 10% above the greatest 15 min sample recorded in the hour

Time:
- 15-minute interval

- 60-minute interval
- 1440-minute interval

Date:
- Year
- Julian Date

For all data:
- Duplicate interval data

3. Research objectives (Campbell Weather Station)

The principal objective is to record long-term meteorological data for North Inlet-Winyah Bay National Estuarine Research Reserve (NIW NERR) in order to observe any environmental changes or trends over time. The data are also used to compliment other biological, chemical, or physical research conducted throughout the reserve, including YSI data.

4. Research methods:

The Campbell Scientific weather station samples every 5 seconds continuously throughout the year to produce 15 minute, hourly, and daily averages. The measurements recorded are air temperature, relative humidity, barometric pressure, rainfall, wind speed, and wind direction. A one-week sampling interval was chosen so that the CR10X would not run out of room and overwrite data, especially if the short haul modem link failed and data could not be sent from the datalogger to the computer. If this were the case, the data would have to be downloaded at the storage module to a laptop or the storage module would be replaced and brought back to the lab for downloading procedures in Section 4.5 of the CDMO Manual. All collected data are QA/QC'ed monthly with the Microsoft Excel pre-processing macro than into the EQWin database. Any error messages are further investigated and the data is changed (if necessary), noted as anomalous, or noted but documented as corrected data. Periodically, sensors on the weather station are inspected for damage or debris. If any are found, it is repaired and/or cleaned. The rain gauge tends to collect the most debris and is cleaned out weekly. Sensors are removed and sent back to Campbell Scientific or independent manufacturers for calibrations annually or bi-annually.

LiCor:

From October 19, 1997 (Julian Day 292) through October 21, 2003 (Julian Date 295), all values less than 0 were altered in the raw data to read 0. As of October 21, 2003 to Present, LiCor values less than 0 were no longer converted to 0 in the CR10X programming, because these values may indicate an incorrect multiplier, calibration problems, or a sensor malfunction. LiCor values were retained because there is a possible maximum signal noise error of +/- 2.214 moles/m^2 over the 15 minute collection interval.

Relative Humidity:

From October 19, 1997 (Julian Day 292) through May 15, 2003 (Julian Date 135), all Relative Humidity values over 100% were altered in the raw data to read 100%. As of May 15, 2003 to Present, Relative Humidity values over 100% were no longer converted to 100% in the CR10X programming, since these values may indicate super saturated air, calibration problems, or a sensor malfunction. The sensitivity of the Temperature/Humidity sensor allows for a –2% to 103% error, therefore, data in this range were retained.

5. Site location and character:

The NIW NERR is located on the Southeastern Atlantic coast of the United States in two tidal estuaries, North Inlet and Winyah Bay, near Georgetown, South Carolina. The North Inlet estuary, located approximately 10 km east of Georgetown, is a bar-built Class C type estuary (Pritchard, 1955). The North Inlet estuary is composed of numerous winding tidal creeks, and is considered a pristine tidal estuary due to minimal anthropogenic impacts. The watershed drains a 24.8 km^2 area of mostly pine forest and a moderately developed residential watershed to the north. The Winyah Bay estuary, classified as a Class B type estuary by Pritchard (1955) and composed of waters that originate in the Blue Ridge Mountains of North Carolina, is one of the largest river-estuary ecosystems on the Eastern Seaboard. It is located 14.4 km south of North Inlet. Winyah Bay drains the sub-basins of 6 major rivers, which are heavily impacted by agriculture, mining, and industry. The rivers drain approximately 46,736 km^2 of uplands and marshes.

The weather station is located at Oyster Landing (OL) pier with the Wind sensor, Temperature and Humidity sensor, Barometric Pressure sensor, and Eppley Pyranometer all located on an aluminum tower, approximately 3.5 meters in height, following the descriptions outlined in the CDMO Manual V 5.0. The Tipping Bucket Rain gauge is located to the NE away from the tower and the platform. The LiCor Sensor is located on a light pole adjacent to the aluminum tower. The sensors were wired to the CR10X following the protocol in the Campbell Scientific Sensor Manual.

Description of the specific sampling station follows:
Oyster Landing (OL) - (lat. 33:20:58; long. 79:11:34). The OL meteorological monitoring site is considered a fairly pristine and undisturbed area located at the end of the OL pier which is also where one of the NIW NERR water quality station sites is located. The pier stretches into the upper reaches of Crabhaul Creek in the mid western portion of North Inlet. The sampling site is located approximately 2.8 km from the headwaters of Crabhaul Creek. The creek directly drains pine forested uplands and wetlands. Salinity can range from 0 - 32 ppt. and average tidal flux is approximately 1.4m. The creek has an average depth of ~2 m Mean High Water (MHW) and average width of ~150m MHW. The bottom mostly is comprised of oyster shell hash with some fine sediment and detritus.

6. Data Collection period:

Meteorological data has been collected by automated weather stations at the Oyster Landing Pier since 1982. Data collection using NERR protocols began July 2, 1997. Long-Term data and metadata from 1982 through 2000 are available online at http://links.baruch.sc.edu/data/. SWMP Data and metadata for 2001 to 2004 are available online at http://cdmo.baruch.sc.edu/.

7. Distribution

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program,

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance/quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient of third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR weather data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see section 1. Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page http://cdmo.baruch.sc.edu/ . Data are available in text format and Access data tables.

8. Associated researchers and projects

The NERR Water Quality Monitoring Project also has a station located at Oyster Landing. The principal objective of this study is to record long-term water quality data for North Inlet - Winyah Bay in order to observe any physical changes or trends in water quality over time. Four sites were chosen; two to represent our pristine site and the other two to represent impacted sites. The Oyster Landing monitoring site is considered a fairly pristine and undisturbed area located at the end of the Oyster Landing pier, which is also where the NIW NERR Meteorological station site is located. The Clambank site is

located near the center of the Reserve and is considered pristine. Debidue Creek and Thousand Acre are both located in waterways that receive run-off from heavily developed areas. Measurements are taken every 30 minutes over roughly two week collecting periods with an YSI 6600 EDS data logger. The parameters measured are specific conductivity, salinity, dissolved oxygen, water temperature, pH, turbidity, and water level. These parameters are important indicators of habitat quality for numerous estuarine species and to determine health criteria and human uses.

A water chemistry program is associated with the NIW NERR core-monitoring program. Variables sampled include: chlorophyll dissolved organic carbon, nitrate-nitrite, orthophosphate, and ammonia. (See documentation on the NIW http://www.northinlet.sc.edu/ home page for further details). Samples for the 20 day program and the monthly grabs are collected at each of the four NERR water-quality monitoring stations. Thousand Acre is our permanent monitoring station for the NERR monitoring program beginning monitoring in 1994. Oyster Landing and Clambank Creek were also sampled beginning in 1993. Debidue Creek monitoring began in 1998. These stations are also included in our NIW core-monitoring program.

a) Monthly grab samples

Our monthly grab samples were initiated across the NERR platform on February 1, 2001 as a method of providing baseline information on inorganic nutrient and chlorophyll a water quality status within the National Estuarine Research Reserve system. The North Inlet-Winyah Bay National Estuarine Research Reserve (NIW NERR) began collecting monthly grab samples on April 17, 2002.

b) Diel Sampling Program (20 day program)

The NIW NERR 20 day water chemistry database is a continuation of the Long-Term Ecological Research (LTER) Daily Water Sample 1978-1993 database whose purpose was to monitor nutrient cycling in the North Inlet Estuary, Georgetown, SC. The Long-Term Ecological Research Project at North Inlet was part of the national network of LTER sites and was funded by the National Science Foundation from October 1980 through 1993. The NERR 20 day water chemistry program was initiated in June of 1993 to continue the monitoring of nutrients in the North Inlet Estuary system and also to continue the long-term database on the nutrient concentration dynamics of the North Inlet salt marsh estuarine system. A larger purpose of this monitoring program is to combine the water chemistry, chlorophyll a, and suspended sediment monitoring data with other existing North Inlet ecological monitoring data to provide ecosystem level information and understanding. Because the LTER daily water sampling collections were taken every day at 10:00am EST, it was determined that the nutrient data are biased for spring high tides; not all tides levels would be represented. The new NERR water chemistry sampling protocols (based on a 10 day cycle) sampled all tidal stages over the years.

A long term fish survey is also done at the Oyster Landing site bi-weekly. Species present, total weight, individual weights and standard lengths of fish that utilize the

marsh at high tide are recorded. In the winter months (November through February), this sampling is done only once monthly.

The National Atmospheric Deposition Program (NADP) (http://nadp.sws.uiuc.edu/) is a nationwide network of precipitation monitoring sites. The network is a cooperative effort between many different groups, including the State Agricultural Experiment Stations, U.S. Geological Survey, U.S. Department of Agriculture, and numerous other governmental and private entities. The purpose of the network is to collect data on the chemistry of precipitation for monitoring of geographical and temporal long-term trends. The precipitation at each station is collected weekly according to strict clean-handling procedures. It is then sent to the Central Analytical Laboratory where it is analyzed for hydrogen (acidity as pH), sulfate, nitrate, ammonium, chloride, and base cations (such as calcium, magnesium, potassium and sodium).

For a more detailed description of the other 85 projects being conducted at the Baruch Marine Field Lab in the NIW NERR, go to the Baruch website. To retrieve the list and the project abstracts go to http://www.cas.sc.edu/baruch/researchers.html then go to the Quick Link box and click on Research Projects Lists.

II. Physical Structure Descriptors:

9. Sensor specifications, operating range, accuracy and date of last calibration:

The following sensors were in service from 05/2001 (LiCor 06/26/01)-5/13/03

Eppley Black and White Pyranometer
Model # 8-48; SN 28070
Resistance: 353 Ω at 23°C
Temperature Compensation Range: -20 to +40°C
Sensitivity: 10.35×10^{-6} volts/watts meter^{-2}
7.22 millivolts/cal cm^{-2} min^{-1}
Date in Use: 05/17/2001-5/13/2003
Date of last calibration: 02/07/2001

Met One Wind Sensor
Model # 034A-L; SN X3121
Range: 0-50 m/s; 360° mechanical
Date in Use: 05/17/2001-5/13/2003
Date of last calibration: 09/28/2001

Temperature and Relative Humidity
Model #: HMP45C; SN U2520001
Operating Temperature: -40-+60°C
Temperature Measurement Range: -40-+60°C
Temperature Accuracy: ± 0.2 °C @ 20°C
Relative Humidity Measurement Range: 0-100% non-condensing

RH Accuracy: +/-2% RH (0-90%) and +/-3%(90-100%)
Uncertainty of calibration: ± 1.2% RH
Date in Use: 09/18/2001-5/13/2003, 02/18/2004-07/12/2004, 08/06/2004-09/02/2004
Date of Last calibration: October 2004

Barometric Sensor
Model # CS-105; SN W1530030 (SN R4230013 replaced under warranty)
Operating Range: Pressure – 600-1060 mb
Temperature: -40-+60C
Humidity: non-condensing
Accuracy: ±0.5 to 6.0 mb (+20-60C)
Stability: ± 0.1 mb per year
Date in Use: 05/17/2001-5/13/2003
Date of Last calibration: new 05/2001

Tipping Bucket Rain Gauge
Model #: TE 525; SN 27988-1200 (new March 2001)
Range: 0.1 mm
Accuracy: 1.0% at <2"/hr
Date in Use: 05/17/2001-present
Date of Last calibration: 3/29/2004

The following sensors were in service from 06/26/01-6/19/2003

LiCor Quantum Sensor
Model # LI190SZ; SN Q18206
Stability: <±2% change over 1 yr
Operating Temperature: -40 to 65°C
Sensitivity: typically 5 μA per 1000μmoles s^{-1} m^{-2}
Light spectrum wavelength: 400 to 700 nm
Date in Use: 06/26/2001-6/19/2003
Date of last calibration: 03/06/2001

The following sensors were in service from 5/13/03 (LiCor 6/19/2003) to present

Eppley Black and White Pyranometer
Model # 8-48; SN 28078
Resistance: 353 Ω at 23°C
Temperature Compensation Range: -20 to +40°C
Sensitivity: 10.35 X 10^{-6} volts/watts $meter^{-2}$
7.22 millivolts/cal cm^{-2} min^{-1}
Date in Use: 8/11/1999-5/17/2001; 5/13/03 to present
Date of last calibration: 12/30/2002

Wind Sentry
Model # 03001-5; SN 8702

Range: 0-50 m/s; 360° mechanical
Dates in Use: 07/1997 thru 05/17/2001, 5/13/2003 to present
Date of last calibration: March 2003

Temperature and Relative Humidity
Model #: HMP35C; SN R2620008
Operating Temperature: -40-+60°C
Temperature Measurement Range: -40-+60°C
Temperature Accuracy: ± 0.2 °C @ 20°C
Relative Humidity Measurement Range: 0-100% non-condensing
RH Accuracy: +/-2% RH (0-90%) and +/-3%(90-100%)
Uncertainty of calibration: ± 1.2% RH
Date in Use: 07/1997 thru 08/11/1999, 05/17/2001 thru 09/18/2001, 5/13/2003 thru 02/18/2004, 9/2/2004 to present
Date of Last calibration: 08/23/2004

Barometric Sensor
Model # CS-105; SN U1120009
Operating Range: Pressure – 600-1060 mb
Temperature: -40-+60C
Humidity: non-condensing
Accuracy: ±0.5 to 6.0 mb (+20-60C)
Stability: ± 0.1 mb per year
Date in Use: 08/11/1999 thru 05/17/2001, 5/13/2003 to present
Date of Last calibration: 12/26/2002

LiCor Quantum Sensor
Model # LI190SB; SN Q26604
Stability: <±2% change over 1 yr
Operating Temperature: -40 to 65°C
Sensitivity: typically 5 μA per 1000μmoles s^{-1} m^{-2}
Light spectrum wavelength: 400 to 700 nm
Date in Use: 07/1997 thru 04/1999, 04/1999 thru 04/19/2000, 03/2001 thru 06/26/2001, 6/19/2003 to present
Date of last calibration: 2/17/2003

Sensors no longer in use:

Tipping Bucket Rain Gauge
Model #: Sierra-Misco Environment Ltd. 2500; SN 1425C
Range: 0.1 mm
Accuracy: ??
Date of Use: 07/1997 thru 05/17/2001
Date of Last calibration: unknown

10. Coded variable indicator and definition.

OL = Oyster Landing
Station Code= niwolmet

11. Anomalies/Suspect Data

January 2004

Anomalies
For the following dates and times, the Air Temperature readings were suspect due to a sensor malfunction and giving sporadic -99999 readings.

01/01/2004	00:00	thru	01/31/2004	24:00

Corrections:
For the following dates and times all LiCor data were edited and corrected due to an incorrect multiplier being used due to the program change out and the multiplier not being changed in the new program. The multiplier was corrected on March 24, 2004.

01/01/2004	00:00	thru	01/31/2004	24:00

February 2004

Anomalies
For the following dates and times, the Air Temperature readings were suspect due to a sensor malfunction and giving sporadic -99999 readings.

02/01/2004	00:15	thru	02/19/2004	11:30

Corrections:
For the following dates and times all LiCor data were edited and corrected due to an incorrect multiplier being used due to the program change out and the multiplier not being changed in the new program. The multiplier was corrected on March 24, 2004.

02/01/2004	00:15	thru	02/29/2004	24:00

March 2004

Anomalies
For the following date and time all the data were suspect due to the power turned off to the CR10X so the YSI connection cable could be disconnected due to troubleshooting malfunctions in the YSI; mainly with the battery. The power was off from 10:20 to 10:23.

Date	Julian Date	Time	Array ID
03/15/04	75	24:00	144

For the following date and time all the data were suspect due to the power turned off to the CR10X due to troubleshooting low voltage readings with the CR10X battery. The battery was changed out at this time. The power was off from 09:05 to 9:07.

Date	Julian Date	Time	Array ID
03/16/04	76	24:00	144

Corrections:
For the following dates and times all LiCor data were edited and corrected due to an incorrect multiplier being used due to the program change out and the multiplier not being changed in the new program. The multiplier was corrected on March 24, 2004; it was changed in program at 9:06am.

03/01/2004	00:15	thru	03/24/2004	09:10

April 2004

Anomalies:
For the following date and time LiCor data were suspect due the value being within the range but lower than normal (-1 moles/m^2). The value is not deleted due to a possible maximum signal noise error of +/- 2.214 moles/m^2 over the 15 minute interval.

Date	Julian Date	Time	Array ID
04/08/04	99	05:30	15

No Corrections

May 2004

No Anomalies

No Corrections

June 2004

Anomalies
For the following dates and times the Air Temperature readings were suspect due to a malfunction with the HMP45 probe producing lower readings than normal on July 12, 2004. NI-WB daily averages were compared to the weather underground website's daily averages and a Kestrel 4000 and determined to be due to actual weather conditions.

06/14/2004	00:15	thru	06/30/2004	24:00

No Corrections

July 2004

Anomalies:
For the following dates and times the Air Temperature readings were suspect due to the malfunctions with the HMP45 probe producing lower readings than normal on July 12, 2004. Daily averages were compared to the weather underground website's daily averages and a Kestrel 4000 and determined to be due to actual weather conditions.

07/01/2004	00:15	thru	07/12/2004	09:30

For the following date and time LiCor data were suspect due the value being within the range but lower than normal (-1.2 moles/m^2). The value is not deleted due to a possible maximum signal noise error of +/- 2.214 moles/m^2 over the 15 minute interval.

Date	Julian Date	Time	Array ID
07/05/04	187	20:45	15

No Corrections

August 2004

Anomalies
For the following dates and times the Air Temperature readings were suspect due to the probe producing lower readings than normal. Daily averages were compared to the weather underground website's daily averages and a Kestrel 4000 and determined to be due to actual weather conditions.

08/06/2004	14:00	thru	08/31/2004	24:00

No Corrections

September 2004

Anomalies
For the following dates and times the Air Temperature readings were suspect due to the probe producing lower readings than normal. Daily averages were compared to the weather underground website's daily averages and a Kestrel 4000 and determined to be due to actual weather conditions.

09/01/04	00:15	thru	09/02/04	09:30

No Corrections

October 2004

Anomalies
For the following dates and times the Rainfall data were suspect. Due to the tipping bucket having tipped when there was no rain, this may be caused by the large amount of bird activity located on the dock, Oyster Landing.

Date	Julian Date	Time	Array ID
10/13/04	287	13:45	15
10/13/04	287	14:00	60
10/13/04	287	24:00	144
10/18/04	292	16:30	15
10/18/04	292	17:00	60
10/18/04	292	24:00	144

For the following dates and times the Cumulative Rainfall data were suspect. Due to the tipping bucket having tipped when there was no rain, this may be caused by the large amount of bird activity located on the dock, Oyster Landing.

10/13/04	13:45	thru	10/13/04	24:00
10/18/04	16:30	thru	10/18/04	24:00

No Corrections

November 2004

No Anomalies

No Corrections

December 2004

No Anomalies

No Corrections

12. Deleted Data

January 2004

For the following dates and times the Air Temperature data were deleted due to a sensor malfunction and giving sporadic -99999 readings. When sent back to Campbell Scientific the -99999 readings were caused by corrosion in the sensor.

Date	Julian Date	Time	Array ID
1/4/2004	4	07:45	15
1/4/2004	4	08:00	60
1/4/2004	4	24:00	144
1/5/2004	5	07:45	15
1/5/2004	5	08:00	60
1/5/2004	5	24:00	144
1/25/2004	25	10:30	15
1/25/2004	25	10:45	15
1/25/2004	25	11:00	60
1/25/2004	25	24:00	144

For the following date and time, all data were deleted due to changes being made to the program. The time stamp was changed from 2400 to 0000, so all sites and equipment were on the same time scale for the new EQWin database.

Date	Julian Date	Time	Array ID
01/30/04	30	15:00	15
01/30/04	30	15:00	60
01/30/04	30	24:00	144

February 2004

For the following dates and times the Air Temperature data were deleted due to a sensor malfunction and giving sporadic -99999 readings. When sent back to Campbell Scientific the -99999 readings were caused by corrosion in the sensor.

Date	Julian Date	Time	Array ID
2/6/2004	37	17:15	15
2/6/2004	37	17:30	15
2/6/2004	37	17:45	15
2/6/2004	37	18:00	15
2/6/2004	37	18:00	60
2/6/2004	37	24:00	144
2/15/2004	46	07:15	15
2/15/2004	46	08:00	60
2/15/2004	46	23:45	15
2/15/2004	46	24:00	60
2/15/2004	46	24:00	144
2/17/2004	48	05:00	15
2/17/2004	48	05:00	60
2/17/2004	48	24:00	144

For the following date and times all data were deleted, due to the power being turned off and the weather tower was dropped for maintenance. The power was off from 13:40 to 14:16.

Date	Julian Date	Time	Array ID
02/18/04	49	14:30	15
02/18/04	49	14:45	15
02/18/04	49	15:00	60
02/18/04	49	24:00	144

For the following date and times all the data were deleted, due to the power being turned off to troubleshoot for the relative humidity errors.

Date	Julian Date	Time	Array ID
02/19/04	50	10:45	15
02/19/04	50	11:15	15
02/19/04	50	12:00	60
02/19/04	50	24:00	144

For the following dates and times all the Relative Humidity data were deleted, due to the wiring of the probe not being placed in the correct ports.

02/18/04 14:30 thru 02/19/04 11:15

For the following date and times all the Cumulative Rainfall were deleted, due to the power of the CR10X being turned off and on, this affects the number of tips from the tipping bucket rain gauge.

02/19/04	10:45	thru	02/19/04	24:00

March 2004

For the following date and times all the data were deleted due to the power turned off to the CR10X so the YSI connection cable could be disconnected due to troubleshooting malfunctions in the YSI; mainly with the battery. The power was off from 10:20 to 10:23.

Date	Julian Date	Time	Array ID
03/15/04	75	10:30	15
03/15/04	75	11:00	60

For the following date and times all the data were deleted due to the power turned off to the CR10X due to troubleshooting low voltage readings with the CR10X battery. The battery was changed out at this time. The power was off from 09:05 to 9:07.

Date	Julian Date	Time	Array ID
03/16/04	76	09:15	15
03/16/04	76	10:00	60

For the following dates and times the Rainfall data were deleted, due to the power of the CR10X being turned off and on, this affects the number of tips from the tipping bucket rain gauge.

Date	Julian Date	Time	Array ID
03/15/04	75	24:00	144
03/16/04	76	24:00	144

For the following date and times all the data were deleted due to troubleshooting for low voltage readings with the CR10X battery. The power was off from 13:10 to 13:11 and from 14:07 to 15:14.

Date	Julian Date	Time	Array ID
03/17/04	77	13:15	15
03/17/04	77	14:15	15
03/17/04	77	14:45	15
03/17/04	77	15:00	15
03/17/04	77	15:00	60
03/17/04	77	15:15	15
03/17/04	77	16:00	60
03/17/04	77	24:00	144

For the following date and times the Rainfall data were deleted due to calibrating the rain gauge which was unsuccessful. The water ran through too fast to have an accurate reading.

Date	Julian Date	Time	Array ID
03/17/04	77	13:30	15
03/17/04	77	13:45	15
03/17/04	77	14:00	60

For the following date and time all data were deleted due to the power of the CR10X being turned off. The HMP45 (Air Temperature/Relative Humidity probe) was disconnected to recover serial number. The power was off from 11:10 to 11:34.

Date	Julian Date	Time	Array ID
03/24/04	84	24:00	144

For the following date and times all data were deleted due to the reloading of the program with the new LiCor multiplier.

Date	Julian Date	Time	Array ID
03/24/04	84	09:15	15
03/24/04	84	10:00	60
03/24/04	84	24:00	144

For the following date and times all data were deleted due to the power of the CR10X being turned off. The HMP45 (Air Temperature/Relative Humidity probe) was disconnected to recover serial number. The power was off from 11:10 to 11:34.

Date	Julian Date	Time	Array ID
03/24/04	84	11:15	15
03/24/04	84	11:30	15
03/24/04	84	11:45	15
03/24/04	84	12:00	60

For the following date and times all Rainfall data were deleted, due to the calibration of the tipping bucket rain gauge.

Date	Julian Date	Time	Array ID
03/29/04	89	14:00	15
03/29/04	89	14:15	15
03/29/04	89	14:30	15
03/29/04	89	14:45	15
03/29/04	89	15:00	15

For the following date and times all the Cumulative Rainfall data were deleted, due to the power of the CR10X being turned off and on, this affects the number of tips from the tipping bucket rain gauge.

03/15/04	10:30	thru	03/15/04	24:00
03/16/04	09:15	thru	03/16/04	24:00
03/17/04	00:15	thru	03/17/04	24:00
03/24/04	09:15	thru	03/24/04	24:00
03/29/04	14:00	thru	03/29/04	24:00

For the following date and time LiCor data were deleted due to the value being outside the range (-3 and -3.8 moles/m^2). With a range of +/- 2.214 moles/m^2 as a possible maximum signal noise error over the 15 minute interval.

Date	Julian Date	Time	Array ID
03/31/04	91	02:00	15

03/31/04	91	02:00	60

April 2004

For the following date and times all data were deleted due to the reloading of the program. Bob Scarbourgh added a sensor (Met One Wind Sensor) to the program that will be deployed in the spring of 2005.

Date	Julian Date	Time	Array ID
04/01/04	92	14:45	15
04/01/04	92	15:00	60
04/01/04	92	24:00	144

May 2004

For the following date and times all data were deleted due to the reloading of the program. This was done so the YSI could be actively recording.

Date	Julian Date	Time	Array ID
05/10/04	131	10:00	15
05/10/04	131	10:00	60
05/10/04	131	24:00	144

June 2004

No Deletions

July 2004

For the following date and times all data were deleted due to the reloading of the program. Wind direction was added to record for the 5 minute data. This data is for Ray Torres, Faculty in the Department of Geological Sciences at University of South Carolina.

Date	Julian Date	Time	Array ID
07/02/04	184	12:30	15
07/02/04	184	13:00	60
07/02/04	184	24:00	144

For the following date and times all data were deleted due to the power of the CR10X being turned off. The HMP45 (Air Temperature/Relative Humidity probe) malfunctioned so it was sent to Campbell Scientific for repairs and calibration, they found corrosion in probe. The power was off from 09:43 to 09:50 and from 12:04 to 12:10 (EST).

Date	Julian Date	Time	Array ID

07/12/04	194	10:00	15
07/12/04	194	10:00	60
07/12/04	194	12:15	15
07/12/04	194	13:00	60
07/12/04	194	24:00	144

For the following dates and times all Air Temperature and Relative Humidity data were deleted due to there not being a sensor deployed on the weather station. Both sensors (HMP45 & HMP35) were sent off for repairs and calibration.

07/12/04	12:15	thru	07/31/04	24:00

For the following date and times all the Cumulative Rainfall data were deleted, due to the power of the CR10X being turned off and on, this affects the number of tips from the tipping bucket rain gauge.

07/12/04	10:15	thru	07/12/04	24:00

August 2004

For the following dates and times all Air Temperature and Relative Humidity data were deleted due to there not being a sensor deployed on the weather station. Both of our HMP sensors were sent off for repairs and calibration.

08/01/04	00:15	thru	08/06/04	13:00

For the following date and times all data were deleted due to the power of the CR10X being turned off. This was done to reconnect the HMP45 (Air Temperature/Relative Humidity probe). The power was off from 12:48 to 12:59; from 13:34 to 13:37; and from 14:05 to 14:07(EST).

Date	Julian Date	Time	Array ID
08/06/04	219	13:00	15
08/06/04	219	13:00	60
08/06/04	219	13:30	15
08/06/04	219	14:00	60
08/06/04	219	14:15	15
08/06/04	219	24:00	144

For the following date and times all data were deleted due to the reloading of the program. This was done to troubleshoot for the YSI graphs on RTDM (Real Time Data Management).

Date	Julian Date	Time	Array ID
08/11/04	224	08:15	15
08/11/04	224	08:30	15
08/11/04	224	09:00	60
08/11/04	224	24:00	144

For the following date and times all Air Temperature data were deleted due to extremely low temperatures (in the negative range) recorded. The HMP45 sensor (Air Temperature/Relative Humidity probe) had been failing before and all data through the end of the month is suspect as a result of.

Date	Julian	Time	Array ID
08/16/04	229	00:15-24:00	15, 60, 144

For the following date and times all data were deleted due to the power of the CR10X being turned off. The HMP45 (Air Temperature/Relative Humidity probe) malfunctioned again. The HMP35 was broken so we left the HMP45 deployed to record humidity data. The power was off from 08:20 to 08:33 and from 09:45 to 09:53 (EST).

Date	Julian Date	Time	Array ID
08/17/04	230	08:45	15
08/17/04	230	09:00	60
08/17/04	230	09:45	15
08/17/04	230	10:00	15
08/17/04	230	10:00	60
08/17/04	230	24:00	144

For the following date and times Barometric Pressure, Air Temperature and Relative Humidity data were deleted due to the cables not being attached to the CR10X.

Date	Julian Date	Time	Array ID
08/17/04	230	09:00	15
08/17/04	230	09:15	15
08/17/04	230	09:30	15

For the following dates and times all the Cumulative Rainfall data were deleted, due to the power of the CR10X being turned off and on, this affects the number of tips from the tipping bucket rain gauge.

08/06/04	13:00	thru	08/06/04	24:00
08/17/04	08:30	thru	08/17/04	24:00

September 2004

For the following date and times all data were deleted due to the power being turned off to the CR10X due to the disconnection of the HMP45 probe. It was sent back to Campbell Scientific for repairs. The HMP35 was deployed in its place. Then the program was reloaded, to activate the HMP 35 probe in the program.

Date	Julian Date	Time	Array ID
09/02/04	246	09:15	15
09/02/04	246	09:30	15
09/02/04	246	10:00	60
09/02/04	246	24:00	144

October 2004

No Deletions

November 2004

For the following dates and times the Air Temperature data were deleted due to the sensor malfunctioning and giving sporadic -99999 readings. When sent back to Campbell Scientific the -99999 readings were caused by corrosion in the sensor.

Date	Julian Date	Time	Array ID
11/23/04	328	18:45	15
11/23/04	328	19:00	60
11/23/04	328	24:00	144

December 2004

No Deletions

13. Missing Data

Missing data are denoted by a blank in the data set. Data are missing due to equipment failure or power loss, where no sensors were deployed, for maintenance or calibration of equipment, elimination of obvious outliers or elimination of data due to calibration problems. For more details on deleted data, see the Anomalous Data/Suspect Data section. To find out more details about missing data, contact the Research Coordinator at the site submitting the data.

Date	Julian Date	Time	Array ID
02/18/04	49	13:45	15
02/18/04	49	14:00	15
02/18/04	49	14:00	60
02/18/04	49	14:15	15
02/19/04	50	10:30	15
02/19/04	50	11:00	15
02/19/04	50	11:00	60
03/17/04	77	14:30	15
05/10/04	131	09:15	15
05/10/04	131	09:30	15
05/10/04	131	09:45	15
07/12/04	194	09:45	15
08/17/04	230	08:30	15
09/02/04	246	08:45	15
09/02/04	246	09:00	15
09/02/04	246	09:00	60

14. Other remarks: annual weather patterns, tropical activity

As a Category 4, Hurricane Charley proved to be destructive as it rampaged through Florida. As Charley decreased to a Category 1 hurricane and made its way toward the South Carolina coast. As a Category 1, Hurricane Charley made landfall at about 09:00 EDT just south of Georgetown, SC at Cape Romain. Between 9:15 EDT and 10:15 EDT the effects of the eye passing near the Oyster Landing Weather Station were seen. The barometric pressure dropped to a minimum of 995 millibars from a normal pressure of 1016 millibars. The wind direction changed from east to north-northwest and the wind speed maximum hit 71.0 mph then dropped to 46.8 mph before increasing again to 63.6mph. At around 11:00 EDT the center of the storm made its way into North Carolina. The official landfall, according to the National Hurricane Center, occurred near Little River Inlet, SC and Calabash, NC.

From the four YSI monitoring sites during the passing of Hurricane Charley. Charley pushed water in during an ebbing (outgoing) tide of about 1.2 – 1.3 feet, therefore, producing significant increases in depth at the 3 North Inlet sites. Depth at our Winyah Bay site, Thousand Acres, was not affected. High Tide was predicted for 08:09 EDT.

Charley dumped 2.3 inches of rain, which was much less than the previous Tropical Storm Bonnie which had 4.8 inches of rain. Before Charley the average salinity at our North Inlet sites was 34 ppt. Pre-storm average salinity at Thousand Acre was 20 ppt. After Charley passed through, the salinity drastically decreased to 1.0, 6.0, 12.0, and 0 ppt at Oyster Landing, Debidue Creek, Clambank Creek and Thousand Acres, respectively. With upland runoff the pH dropped and turbidity increased.

1/8/04 Rain, 0.5 mm. Late night. Josh from Marysis said to always have PC208W disconnected for the black box to be able to collect data. Only connect when need to acquire data or troubleshooting.

3/15/04 Battery voltage began to dropped at 5:00 (11.5) through 5:30 (7.99 lowest) than gradually increased to 13.156 at 8:00. 10:20 -10:23 CR10X disconnected so we could remove the YSI cable due to a malfunction. **No rain**, raingage tipped due to troubleshooting and the connecting with CR10X. 10:45 connected to PC208.

8/1/04 Rain, 0.01 inches, 0.254mm. Tropical Strom Alex (offshore of Charleston).

8/2/04 Rain, 0.25 inches, 6.35mm. Tropical Strom Alex (offshore of Charleston). Early morning & Late Night. 8:00 EST - Created new monthly files. 7:30 EST - Critical updates - shut down & restarted computer.

8/12/04 Rain, 4.83 inches, 122.68mm. Tropical Strom Bonnie.

8/14/04 Rain, 2.32 inches, 58.93mm. Hurricane Charley passed over Georgetown about 10-12 DST.

9/6/04 Rain, 0.36 inches, 9.14mm. Hurricane Frances. 0.42 inches in-situ.

CR10X – Air temp 27.1 C, Heat index 33.8 C / 88.6 F
Kestrel – Air temp 27.7 C, Heat index 34.0 C
7:45 EST disconnected to PC208, was connected all weekend.

9/8/04 Rain, 0.22 inches, 5.59mm. Hurricane Frances

9/9/04 Rain, 0.03 inches, 0.762mm. Hurricane Frances
12:43 EST Changed Desiccant packs.

9/26/04 Rain, 0.52 inches, 13.21mm. Hurricane Jeanne

9/27/04 Rain, 0.23 inches, 5.84mm. Hurricane Jeanne
Wind Speed max 38.0mph.
9:40 EST - 0.60 inches in-situ.

9/28/04 Rain, 0.01 inches, 0.254mm. Hurricane Jeanne
7:30 EST connected to PC208.

11/1/04 9:00 EST - Created new monthly files.
10:15 EST – 0.13 inches in-situ.
Tipping Raingage was clogged w/ Bird droppings.
8:30 EST connected & at 11:15 EST disconnected PC208.

11/9/04 8:30 EST connected to PC208.
8:30 EST Changed Desiccant packs.
9:00 EST – 0.15 inches in-situ.
Tipping Raingage was clogged w/ Bird droppings.

Rain Events:

Daily, Monthly, and Annual Precipitation Totals

niwolmet	Oyster Landing Weather
	Daily Precip Totals (mm)
January	
1/8/2004	0.5
1/9/2004	9.4
1/18/2004	3
1/25/2004	2.3
1/26/2004	29
Monthly Total (mm)	44.2
February	

2/3/2004	6.6
2/4/2004	0.3
2/6/2004	6.4
2/9/2004	0.8
2/11/2004	1.8
2/12/2004	30.2
2/14/2004	9.4
2/15/2004	7.9
2/17/2004	18
2/22/2004	0.3
2/25/2004	0.8
2/26/2004	17
2/27/2004	5.8
Monthly Total (mm)	105.3

March	
3/6/2004	0.3
3/9/2004	5.8
3/16/2004	0.26
3/18/2004	0.3
3/21/2004	0.5
3/30/2004	3.8
3/31/2004	4.8
Monthly Total (mm)	15.8

April	
4/1/2004	0.3
4/2/2004	0.3
4/8/2004	8.9
4/12/2004	14.5
4/13/2004	13.7
4/26/2004	3.3
4/27/2004	15
4/30/2004	2.3
Monthly Total (mm)	58.3

May	
5/1/2004	32
5/2/2004	25.4
5/3/2004	11.4
5/19/2004	13
5/29/2004	8.4

Monthly Total (mm)	90.2

June	
6/3/2004	9.7
6/4/2004	4.6
6/10/2004	0.5
6/11/2004	0.3
6/13/2004	0.5
6/17/2004	4.8
6/27/2004	30
6/28/2004	3
6/29/2004	13.2
6/30/2004	19.1

Monthly Total (mm)	85.7

July	
7/1/2004	7.6
7/2/2004	8.6
7/3/2004	7.4
7/4/2004	0.5
7/5/2004	11.2
7/9/2004	0.5
7/10/2004	6.4
7/11/2004	3
7/12/2004	1.02
7/17/2004	13.5
7/18/2004	25.7
7/19/2004	4.1
7/22/2004	0.8
7/23/2004	11.4
7/24/2004	0.8
7/28/2004	0.3
7/29/2004	1.3
7/30/2004	2.5

Monthly Total (mm)	106.6

August	
8/1/2004	0.3
8/2/2004	6.4
8/3/2004	9.9
8/6/2004	4.3
8/12/2004	122.7
8/13/2004	19.1
8/14/2004	58.9

8/15/2004	48
8/16/2004	0.8
8/25/2004	0.3
8/26/2004	17.8
8/27/2004	10.9
8/28/2004	20.8
8/29/2004	43.7
8/31/2004	19.8
Monthly Total (mm)	383.7
September	
9/1/2004	6.4
9/6/2004	9.1
9/8/2004	5.6
9/9/2004	0.8
9/11/2004	13.7
9/16/2004	0.3
9/17/2004	6.4
9/26/2004	13.2
9/27/2004	5.8
9/28/2004	0.3
9/30/2004	1
Monthly Total (mm)	62.6
October	
10/2/2004	0.5
10/3/2004	36.6
10/13/2004	0.3
10/15/2004	11.9
10/18/2004	0.3
10/19/2004	0.3
10/20/2004	9.1
10/24/2004	0.3
10/28/2004	2.8
Monthly Total (mm)	62.1
November	
11/4/2004	3.6
11/11/2004	7.4
11/12/2004	7.9
11/13/2004	0.3
11/23/2004	0.3
11/24/2004	1

11/25/2004	0.5
11/27/2004	29.2
11/28/2004	2.5
Monthly Total (mm)	52.7
December	
12/9/2004	3
12/10/2004	6.6
12/17/2004	0.5
12/23/2004	0.8
12/25/2004	6.4
12/26/2004	31.8
Monthly Total (mm)	49.1
Annual Total (mm)	1116